$\frac{6}{11} - \frac{5?2}{108}$

$\frac{30-22}{55} = \frac{8}{55}$

Arithmetic Coding :

previous (high − low)

$low = previous\ low + (prob)(range)$

$high = previous\ low + (prob)(range)$

$P(A) = 0.5$

$P(B) = 0.25$

$P(C) = 0.25$

symbol	prob	Cumulative	low	high
A	0.5	0.5	0	0.5
B	0.25	0.75	0.5	0.75
C	0.25	1	0.75	1

Encoding Sequence "BACA":

Encode "B": $low = 0 + (0.5)(1) = 0.5$, $high = 0 + (0.75)(1) = 0.75$

low diff

Encode "A": $low = 0.5 + (0)(0.25) = 0.5$

$high = 0.5 + (0.5)(0.25) = 0.625$

Encode "C": $low = 0.5 + (0.75)(0.125) = 0.59375$

$high = 0.5 + (1)(0.125) = 0.625$

Encode "A": $low = 0.59375 + (0)(0.03125) = 0.59375$

$high = 0.59375 + (0.5)(0.03125) = 0.609375$

Sym	prob	Cumula	low	high
a	2/3	2/3	0	2/3
b	1/3	1	2/3	1

"abba":

"a": $low = 0 + (0)(1) = 0$, $high = 0 + (2/3)(1) = 2/3$

$low = 0 + (2/3)(2/3) = 4$ [illegible], $high = 0 + (1)(2/3) = 2/3$

JPEG → Lossy image compression method.

DCT transform on JPEG relies on three observa

obser I: spatial frequency.

DCT formalises with the measure of how much the image contents change in relation to the number of cycles of a cosine wave per block.

obser 2: psychophysical experiments.
↳ humans will not notice high spatial frequency components.

obser 3: visual acuity (accuracy in distinguishing closed spaced lines) is much greater for gray ("black & white") than for color.

Steps followed in JPEG compression: (JPEG Compr pgpel)

→ JPEG Bitstream → frame, scan, segment, block (8x8 pixels).
frame header
scan header

→ Drawbacks of JPEG
↳ poor low bit rate compression. (low bit rates)
↳ Lossy and lossless compression
↳ Random access of the bit stream
↳ large image handling (larger than 64K by 64K)
↳ single compression architecture. (44 modes)
↳ ~~large image handling~~ transmission in noisy environments
↳ computer generated images and documents.

JPEG 2000: (DWT)

1. preprocessing step - [tiling, conversion to Y CrCb formats and level offsetting]. → partitioning into rectangular, equal sized & non overlap
↳ shifting dc levels by subtracting a const. value from each pixel

2. Discrete Wavelet Transform (DWT)
↳ It represents a signal in both time and frequency using a set of basis functions called wavelets.
[LL, HL, LH, HH]
JPEG now supports 0 to 32 stages, usually 4 to 8 stages are used for natural images.

3. Quantization.
↳ scalar quantization.
$$q_b(u,v) = \text{sign}(a_b(u,v)) \left\lfloor \frac{|a_b(u,v)|}{\Delta_b} \right\rfloor$$

4. Encoding. → block based encoding scheme (EBCOT)
Embedded Block Coding with Optimized Truncations).
↳ typically 64 x 64

[precinct, packet, code block] → three spatially consistent rectangles called packets, each precinct further divided as code block
each subband is divided into rectangular blocks called precincts

Entropy coding (Bit planes]. ⇒ coefficients in code blocks separated into bit planes.

1-3 coding passes.

[insignificant, significant, refinement].

The coding passes are:

↳ Significance propagation pass

↳ magnitude refinement pass

↳ clean up pass.

Entropy coding (MQ coder]

↳ context based adaptive binary arithmetic coding for exploiting the redundancy of the bit planes.

↳ receives binary symbols in a source sequence ⇒ along with their corresponding probabilities.

⇓ produces codestream with a length at most two bits greater than the combined ideal codelengths.

↳ tier-1 (T1) coding.

JPEG 2000 versus JPEG

Video Compression:

compress ratio required ratio is $= \frac{1.5\ Gbps}{18\ Mbps} \approx \frac{83}{1}$

Image compression techniques exploit both spatial & spectral redundancy.

spatial redundancy is due to the correlation between neighbouring pixels.

spectral redundancy is due to the correlation between different color planes

→ However, higher compression rates can be achieved by exploiting another kind of redundancy temporal redundancy.

→ videos also correlated across frames.

→ Key idea in video compression (predicting a new frame from previous frame)

Macro blocks (16×16 pixels) called macro blocks. ↳ [target frame reference frame motion compensation]

I (Intra) frames (Independent frames)

P (or) Inter (predictive) frame Not independent.

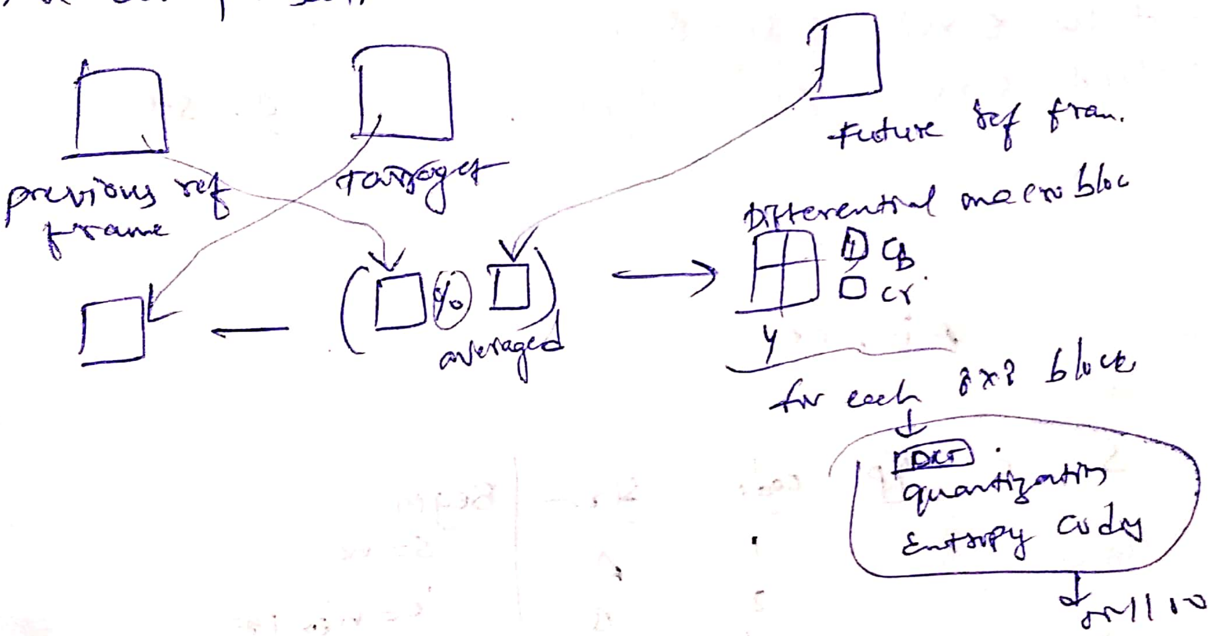
↳ these frames are predicted from (I or P)

↳ coded by forward predictive coding.

MPEG introduces a new B-frame. (It is coded with reference to both previous and future reference frames (either I or P).
~~when~~ when prediction is from previous frame: (forward prediction)
when prediction is from future frame: (backward prediction)

MPEG-1 Evolution:
↳ MPEG-1 supports only non interlaced video.
↳ uses 4:2:0 chroma subsampling.
MPEG-1 layer I, MPEG-1 layer II, MPEG-1 Layer III popularly known as MP3

Motion Compensation in MPEG-1



→ MPEG frame sequence.

Display order: I B B P B B P B B I B B

Coding and transmission order: I P B B P B B I B B

~~PBP~~ BPI

IPB

IBB

I ~~B~~ P B B ~~B~~ P B B ~~B~~ I BB

I B B

P

P B B ~~B~~ P B B I B B

Quality of Service depends on many parameters :
- Bandwidth
- Latency (maximum frame / packet delay)
- Packet loss (or) error rate
- Jitter
- Sync skew

Sample requirements of QoS. ⇒

Better categorization of QoS levels :

best-effort service (lack of QoS)
differentiated service (soft QoS)
guaranteed service (hard QoS).

S = S+c

A B A B B

S	C	o/p	code	str
			1	A
			2	B
			3	C
A	B	1	4	AB
B	A	2	5	BA
A	B			
AB	B	4	6	ABB
B				

Begin
S = ne
c = nex i/p
S+c in d
S = S+c.
else
o/p F

LZW decompr :
S = NIL
while not EOF
k = next i/p code.